

# ANNUAL REPORT FOR 2007



**Marks Creek Mitigation Site**  
**Wake County**  
**TIP No. R-2547WM**



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## **SUMMARY**

The following report summarizes the monitoring activities that have occurred in the past year at the Marks Creek Mitigation Site. This site was originally constructed in 2002. Monitoring activities in 2007 represent the fourth year of monitoring for the site. The site must be monitored for five consecutive years or until the site is deemed successful.

Site hydrology is monitored with thirteen groundwater gauges, three surface water gauges, and one onsite rain gauge. Per a resource agency request, an additional groundwater-monitoring gauge (MCGW-13) was installed in July 2005. There are four vegetation-monitoring plots established throughout the wetland enhancement and restoration areas.

This report utilizes rainfall data from both a local weather station and from an on-site rain gauge. The NC State Climate Office provided historical data for the Raleigh/Durham weather station.

Hydrologic monitoring indicated that three of the seven monitoring gauges located in zone 1 met the hydrology success criteria of 12.5% for the 2007-growing season. One of the six monitoring gauges located in zones 2 and 3 met the hydrology success criteria of 8.0%. NCDOT will investigate the gauges that failed to meet the success criteria during the 2007-monitoring year.

Based on the results of the fourth year of monitoring, the site revealed an average density of 603 trees per acre, which is well above the minimum success criteria of 290 trees per acre.

An on-site agency meeting was held in August 2005 to review the location of the new gauge (MCGW-13) that was installed in July 2005. It was observed that a small portion of Zone 1, located just south between GW-7 and GW-8, is situated on a knoll. All of Zone 1 has currently been debited, therefore if this area needs to be addressed in the future, available credits from zones 2 and 3 should be considered as compensation.

An on-site agency meeting was held in April 2006 to review the stability of the stream restoration. Six days prior to the onsite meeting, a severe storm occurred damaging a transformer at a Progress Energy Substation upstream of the mitigation site. Approx. 16,000 gallons of mineral oil was spilled into the UT to Marks Creek. Cleanup activities occurred for several weeks after the spill and at this time the site continues to recover with much of the affected vegetation returning.

NCDOT will continue hydrology and vegetation monitoring at the Marks Creek Mitigation Site.

## **1.0 INTRODUCTION**

### **1.1 Project Description**

The Marks Creek Mitigation Site is located approximately two miles southeast of Knightdale off of Knightdale-Eagle Rock Road (SR 2501). The site is immediately adjacent to the Knightdale Bypass. The site consists of wetland restoration and enhancement areas. It was constructed in 2002 and planted in 2003. The restoration area is 12.66 acres, however only 4.4 acres of zone 1 have been debited.

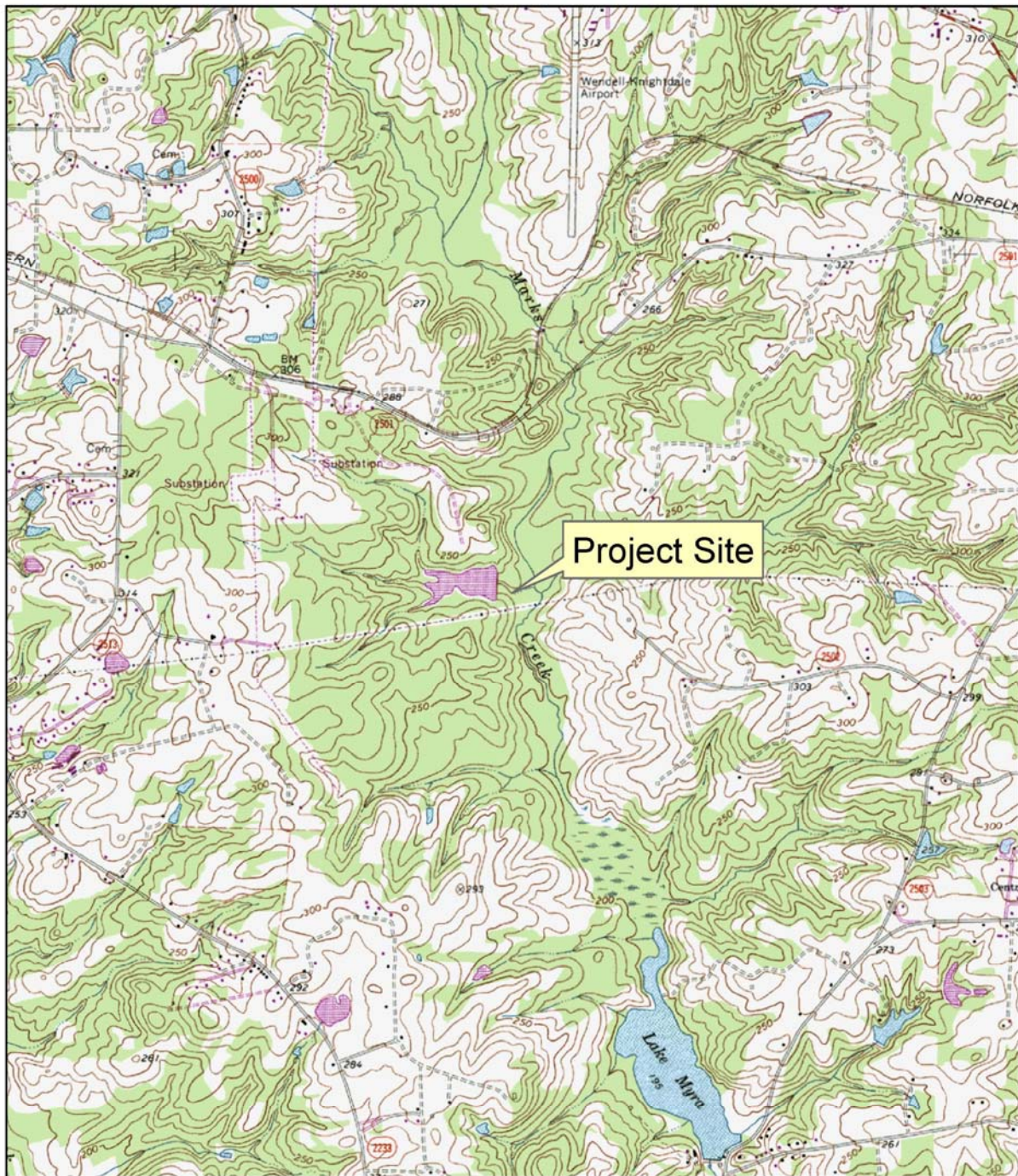
### **1.2 Purpose**

In order to demonstrate successful mitigation, hydrologic and vegetation monitoring must be conducted for a minimum of five consecutive years or until the site is deemed successful. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival.

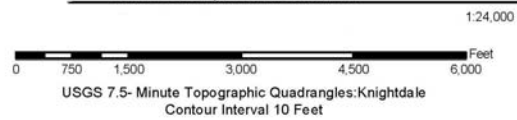
Activities in 2007 reflect the fourth year of monitoring following the restoration efforts. Included in this report are analyses of hydrologic and vegetation monitoring results, as well as local climate conditions throughout the growing season, and site photographs.

### **1.3 Project History**

March 2002	Enhancement and Upland Areas Planted
April 2003	Restoration Area Planted
March 2004	Supplemental Planting in Restoration Area
March-November 2004	Hydrology Monitoring (1 yr.)
June 2004	Vegetation Monitoring (1 yr.)
March-November 2005	Hydrology Monitoring (2 yr.)
July 2005	Vegetation Monitoring (2 yr.)
March-November 2006	Hydrology Monitoring (3 yr.)
July 2006	Vegetation Monitoring (3 yr.)
March-November 2007	Hydrology Monitoring (4 yr.)
July 2007	Vegetation Monitoring (4 yr.)



PROJECT VICINITY  
 Marks Creek  
 Stream and Wetland Mitigation Project  
 Wake County, North Carolina



**Figure 1. Site Location Map**

## **2.0 HYDROLOGY**

### **2.1 Success Criteria**

In accordance with the mitigation plan and permit for wetland mitigation, the success criteria for hydrology state that zone 1 must be inundated or saturated (within 12" of the surface) by surface or groundwater for at least a consecutive 12.5% of the growing season. Zones 2 and 3 must be inundated or saturated (within 12" of the surface) by surface or groundwater for at least a consecutive 8.0% of the growing season. Areas inundated or saturated for less than 5% of the growing season are always classified as non-wetlands. Areas inundated or saturated between 5% and the minimum successful saturation period (8 – 12.5%) can be classified as wetlands depending upon factors such as the presence of wetland vegetation and hydric soils.

The growing season in Wake County begins March 26 and ends November 10. These dates correspond to a 50% probability that temperatures will not drop to 28°F or lower after March 26 and before November 10.<sup>1</sup> The growing season is 229 days; therefore, hydrology for 12.5% of the growing season is at least 29 consecutive days, while 8.0% is at least 18 consecutive days. Local climate must also represent average conditions for the area.

### **2.2 Hydrologic Description**

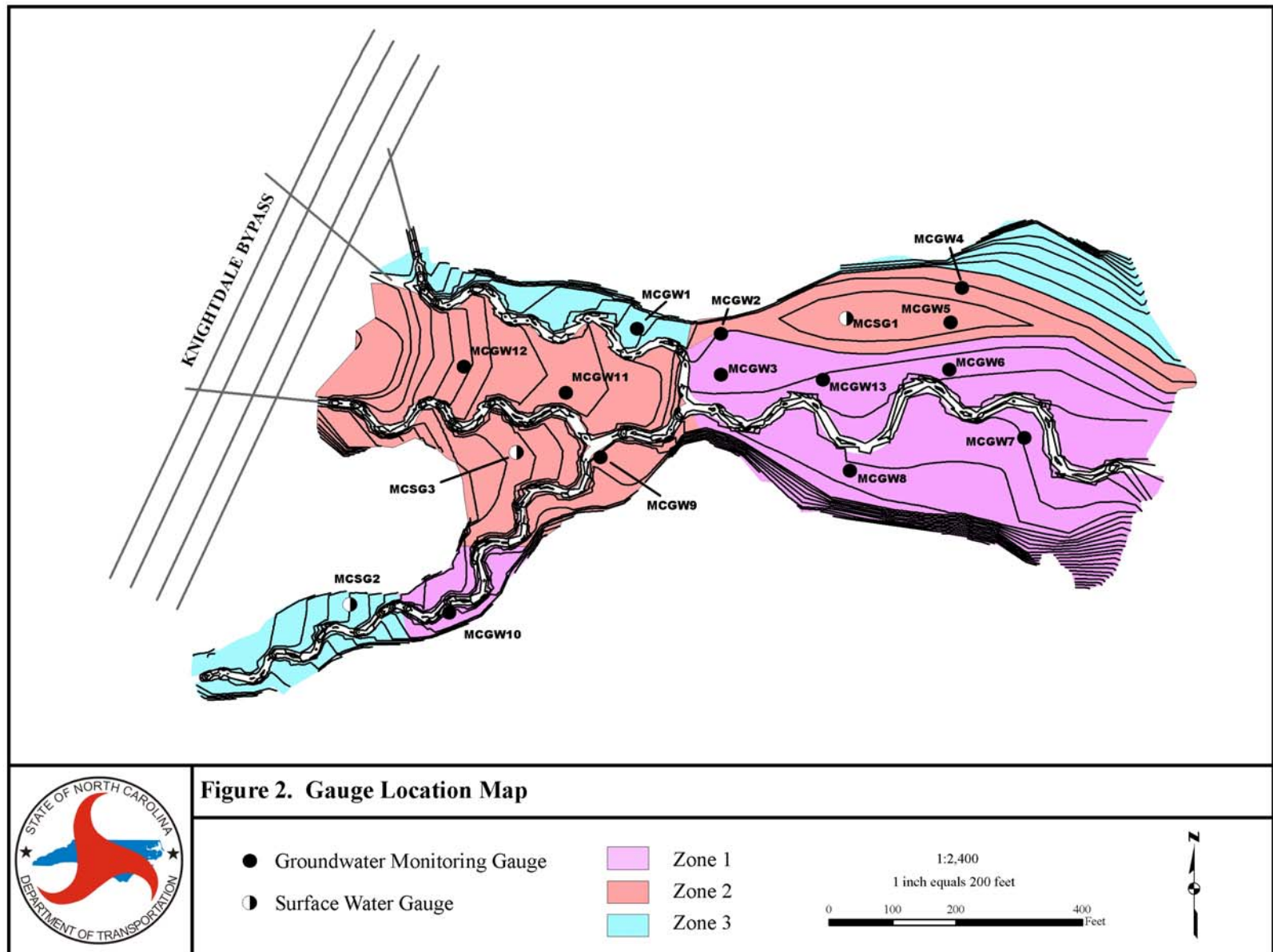
In June of 2003, twelve groundwater-monitoring gauges and three surface water-monitoring gauges were installed across the site (Figure 2). In July of 2005, one additional groundwater gauge was installed. The groundwater gauges are set to record daily water levels, while the surface water gauges are set to record at 4-hour intervals. A rain gauge is also located on the site in order to get accurate site rainfall measurements. The hydrologic response (groundwater) to rainfall events is evaluated using this data.

The Marks Creek site was designed to receive hydrologic input from rainfall and water accessing the floodplain. The hydrologic monitoring should show the reaction of the groundwater level to specific rainfall events, as well as the surface water level.

The site consists of wetland restoration and enhancement areas. The restoration area is 12.66 acres, however only 4.4 acres of Zone 1 have been debited.

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<sup>1</sup> Natural Resources Conservation Service, Soil Survey of Wake County, North Carolina, p. 79.



**Figure 2. Gauge Location Map**

## **2.3 Results of Hydrologic Monitoring**

### **2.3.1 Site Data**

The maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each well. This number was converted into a percentage of the 229-day growing season (March 26 – November 10). The results are presented in Table 1.

Appendix A contains a plot of the groundwater depth for each monitoring well. If the gauge shows saturation for greater than 12.5% (Zone 1) or 8% (Zones 2 & 3) of the growing season, the maximum number of consecutive days is noted on each graph. The individual precipitation events are shown on the monitoring well graphs as bars.

Figure 3 provides a graphical representation of the hydrologic results. Gauges highlighted in blue indicate wetland hydrology for more than 12.5% of the growing season. Gauges highlighted in red show hydrology between 8% and 12.5% of the season, while those in green indicate hydrology between 5% and 8% of the season. Gauges highlighted in black indicate no wetland hydrology (less than 5% of the growing season). Please note that gauges shown in red or blue meet the hydrology criteria in Zones 2 & 3.

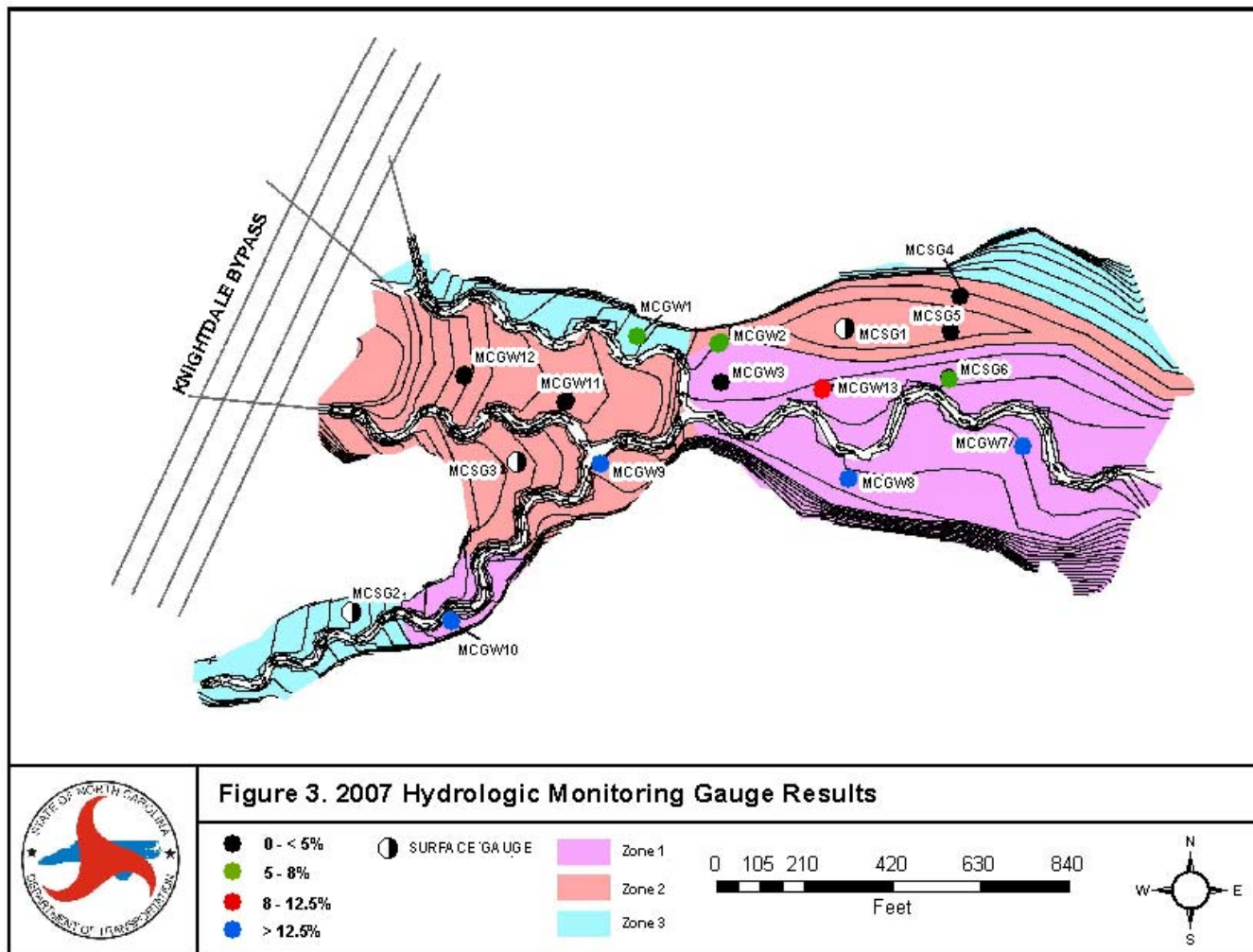
**Table 1. Hydrologic Monitoring Results**

Monitoring Well	Zone	Expected	<5%	5-8%	8-12.5%	>12.5%	Actual %	Success Dates
MCGW 1	3	>8.0		×			6.5	
MCGW 2	1	>12.5		×			6.1	
MCGW 3	1	>12.5	×				3.0	
MCGW 4	2	>8.0	×				1.7	
MCGW 5	2	>8.0	×				0.9	
MCGW 6	1	>12.5		×			5.2	
MCGW 7+	1	>12.5				×	100.0	Mar 26-Nov 10
MCGW 8+	1	>12.5				×	61.7	Mar 26-Aug 14
MCGW 9+	2	>8.0				×	100.0	Mar 26-Nov 10
MCGW 10+	1	>12.5				×	100.0	Mar 26-Nov 10
MCGW 11	2	>8.0	×				1.7	
MCGW 12	2	>8.0	×				1.3	
MCGW 13	1	>12.5			×		12.2	

+Gauge met success criterion during an average rainfall month (April, August, and October).

*Specific Gauge Problems:*

- Gauges (MC- 2,11, &12) experienced battery malfunction during the months of (June 23 - Aug 8).
- Gauge (MC-5) experienced malfunction during the months of (March 26- April 18).



**Figure 3. 2007 Hydrologic Monitoring Results**

### **2.3.2 Climatic Data**

Figure 4 provides an examination of the local climate in comparison with historical data in order to determine whether 2007 was “average” in terms of climate conditions. The two lines represent the 30<sup>th</sup> and 70<sup>th</sup> percentiles of monthly precipitation for Raleigh. The bars are the monthly rainfall totals for November 2005 through November 2007. The NC State Climate Office collected the historical data for the Raleigh/Durham weather station.

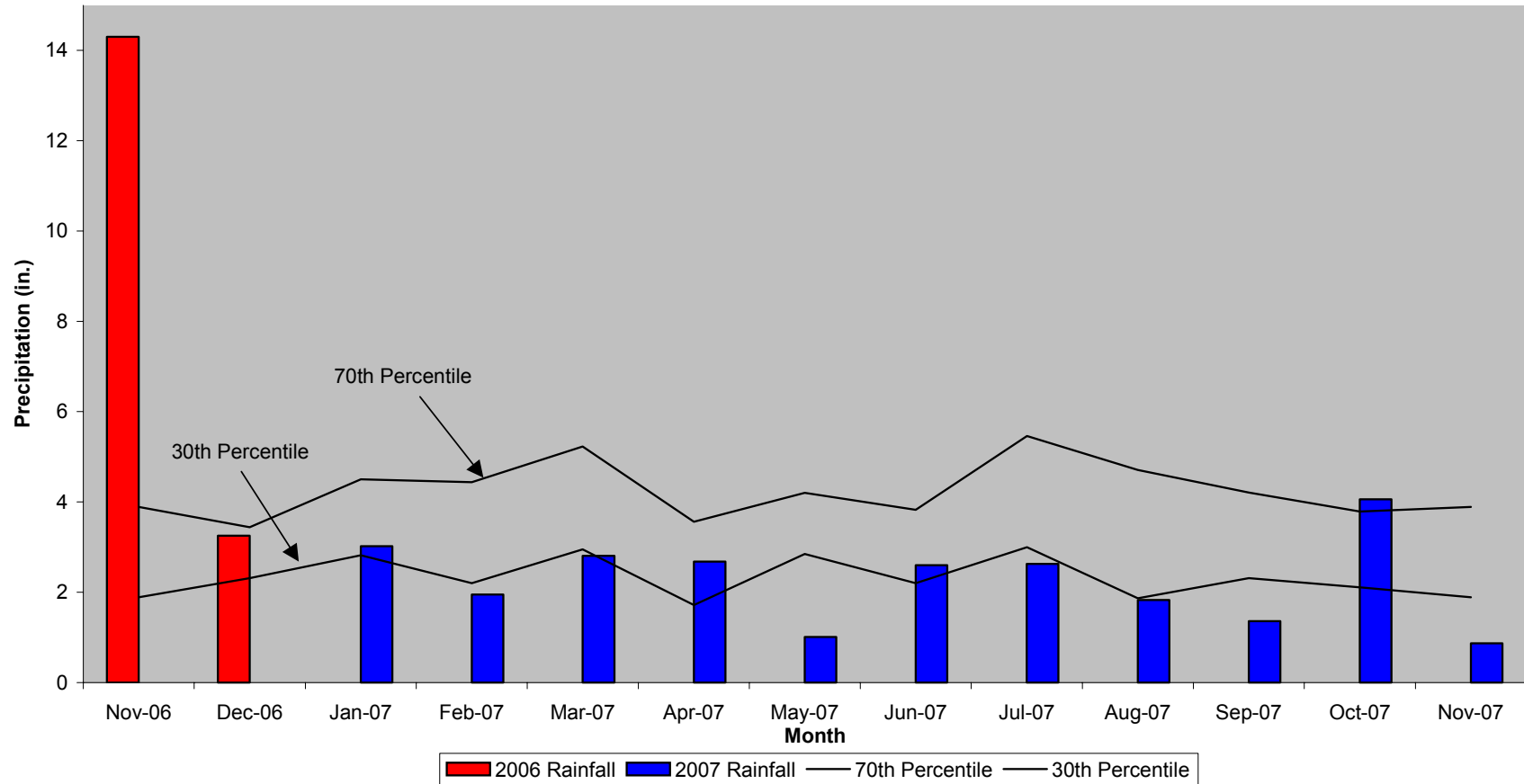
For the 2007-year the below average rainfall months include: May, June, July, August, September, October, and November. The months of January, February, and March recorded average rainfall. Overall, the site experienced below average rainfall in 2007 due to the drought.

### **2.4 Conclusions**

The 2007-year represents the fourth year of hydrology monitoring on the Marks Creek Site. Three of the seven monitoring gauges located in zone 1 met the hydrology success criteria of 12.5% for the 2007-growing season. One of the six monitoring gauges located in zone 2 and 3 met the hydrology success criteria of 8.0%. Gauges MCGW-1, MCGW-2, MCGW-3, MCGW-4, MCGW-5, MCGW-6, MCGW-11, MCGW-12, and MCGW-13 did not indicate successful hydrology. All three surface water gauges demonstrated periods of inundation throughout the growing season.

NCDOT will continue to monitor hydrology at the Marks Creek Mitigation Site.

**Marks Creek  
30-70 Percentile Graph  
Raleigh, NC**



**Figure 4. 30-70 Percentile Graph**

### **3.0 VEGETATION: MARKS CREEK MITIGATION SITE (YEAR 4 MONITORING)**

#### **3.1 Success Criteria**

The success criteria state that there must be a minimum of 320 trees per acre living for at least three consecutive years. A minimum of 290 trees per acre must be living at year 4, and a minimum of 260 trees per acre must be living at year 5.

#### **3.2 Description of Species**

The following tree species were planted in the Wetland Restoration Area:

*Taxodium distichum*, Baldcypress

*Fraxinus pennsylvanica*, Green Ash

*Nyssa aquatica*, Water Tupelo

*Quercus falcata* var. *pagodaefolia*, Cherrybark Oak

*Liriodendron tulipifera*, Yellow Poplar

*Quercus michauxii*, Swamp Chestnut Oak

*Platanus occidentalis*, Sycamore

The following tree species were planted in the Wetland Enhancement Area:

*Fraxinus pennsylvanica*, Green Ash

*Quercus lyrata*, Overcup Oak

*Nyssa sylvatica* var. *biflora*, Swamp Blackgum

*Taxodium distichum*, Baldcypress

The following tree species were planted in the Upland Area:

*Quercus falcata* var. *pagodaefolia*, Cherrybark Oak

*Quercus nigra*, Water Oak

*Quercus phellos*, Willow Oak

*Quercus falcata* var. *falcata*, Southern Red Oak

### 3.3 Results of Vegetation Monitoring

**Table 2.** Vegetation Monitoring Statistics

Plot #	Overcup Oak	Swamp Blackgum	Baldcypress	Green Ash	Water Tupelo	Cherrybark Oak	Yellow Poplar	Swamp Chestnut Oak	Sycamore	Total (4 Year)	Total (at planting)	Density (Tree/Acre)
1 (Enhancement)	3		15	6						24	39	418
2			19	4	7	1	4	1	2	38	38	680
3			4	5	1	13	11	4	10	48	48	680
4			11	9	5	1	2	8	4	40	43	633
<b>Average Tree Density</b>												<b>603</b>

\* Plot 1 is located in the Wetland Enhancement area.

**Site Notes:** Other species noted: **Enhancement Area:** *Scirpus* sp., red maple, *Juncus* sp., *Sagittaria* sp., cattail, cut grass, and various grasses. Swamp blackgum were noted in areas outside of plot 1. There is still some beaver activity occurring in the Enhancement Area. **Restoration Area:** red maple, sweetgum, goldenrod, sedge, tear-thumb, lespedeza, woolgrass, *Baccharis* sp., black willow, *Scirpus* sp., fennel, *Juncus* sp., *Pluchea* sp., pine, smartweed, silky dogwood, alder, cattail, and various grasses.

### 3.4 Conclusions

Approximately 13.49 acres of this site were planted in the wetland enhancement area and 6 acres of this site were planted in the upland area in March 2002. Approximately 12.66 acres of this site were planted in the wetland restoration area in April 2003. The wetland restoration area was supplementally planted in March 2004 due to low survival of trees observed the previous year. There were four vegetation plots established throughout the wetland enhancement and restoration areas. The 2007 vegetation monitoring revealed an average density of 603 trees per acre, which is well above the minimum success criteria of 290 trees per acre.

NCDOT will continue vegetation monitoring at the Marks Creek Mitigation Site.

## **4.0 OVERALL CONCLUSIONS/RECOMMENDATIONS**

For the fourth year of monitoring, three of the seven monitoring gauges located in zone 1 met the hydrology success criteria of 12.5% for the 2007-growing season. One of the six monitoring gauges located in zones 2 and 3 met the hydrology success criteria of 8.0%. Gauges MCGW-1, MCGW-2, MCGW-3, MCGW-4, MCGW-5, MCGW-6, MCGW-11, MCGW-12, and MCGW-13 did not indicate successful hydrology. All three surface water gauges demonstrated periods of inundation throughout the growing season. The failure of the nine-groundwater gauges to meet the success criteria is attribute to the extreme drought conditions experienced in the area during the 2007 growing season

There were four vegetation-monitoring plots established throughout the wetland enhancement and restoration areas. Based on the results of the fourth year of monitoring, the site revealed an average density of 603 trees per acre, which is well above the minimum success criteria of 290 trees per acre.

An on-site agency meeting was held in August 2005 to review the location of the new gauge (MCGW-13), which was installed in July 2005. It was observed that a small portion of Zone 1, located just south between GW-7 and GW-8, is situated on a knoll. All of Zone 1 has currently been debited, therefore if this area needs to be addressed in the future, available credits from zones 2 and 3 should be considered as compensation.

An on-site agency meeting was held in April 2006 to review the stability of the stream restoration. Six days prior to the onsite meeting, a severe storm occurred damaging a transformer at a Progress Energy Substation upstream of the mitigation site. Approx. 16,000 gallons of mineral oil was spilled into the UT to Marks Creek. Cleanup activities occurred for several weeks after the spill and at this time the site continues to recover with much of the affected vegetation returning.

NCDOT will continue hydrology and vegetation monitoring at the Marks Creek Mitigation Site.

**APPENDIX A**

**GAUGE DATA GRAPHS**

**APPENDIX B**

**SITE PHOTOS & PLANTING PLAN**

# Marks Creek



Photo Point #1 (South)



Photo Point #2 (East)



Photo Point #3 (East)



Photo Point #4 (West)



Photo Point #4 (Northeast)



Photo Point #5 (North)

# Marks Creek

## RESTORATION AREA



Photo 1



Photo 2



Photo 3



Photo 4

# Marks Creek

Enhancement Area



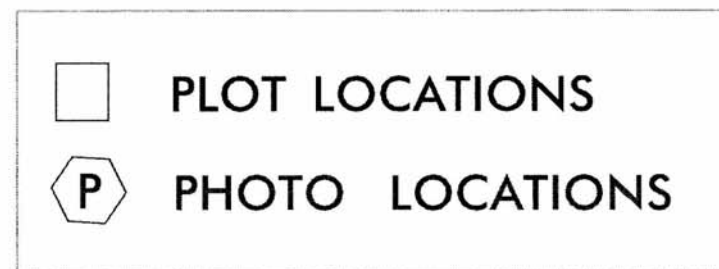
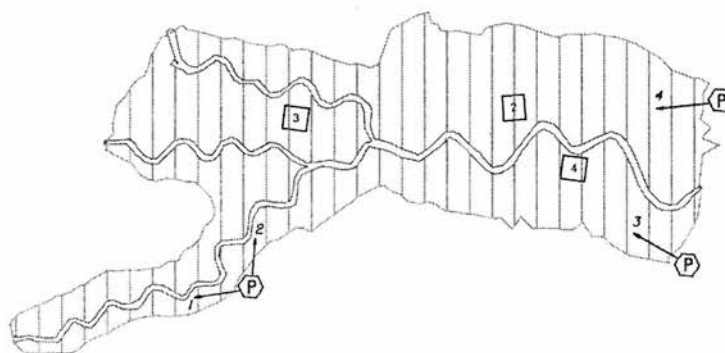
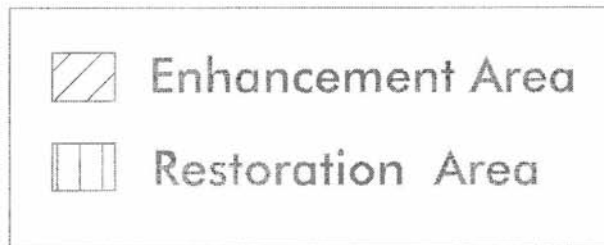
Photo 5

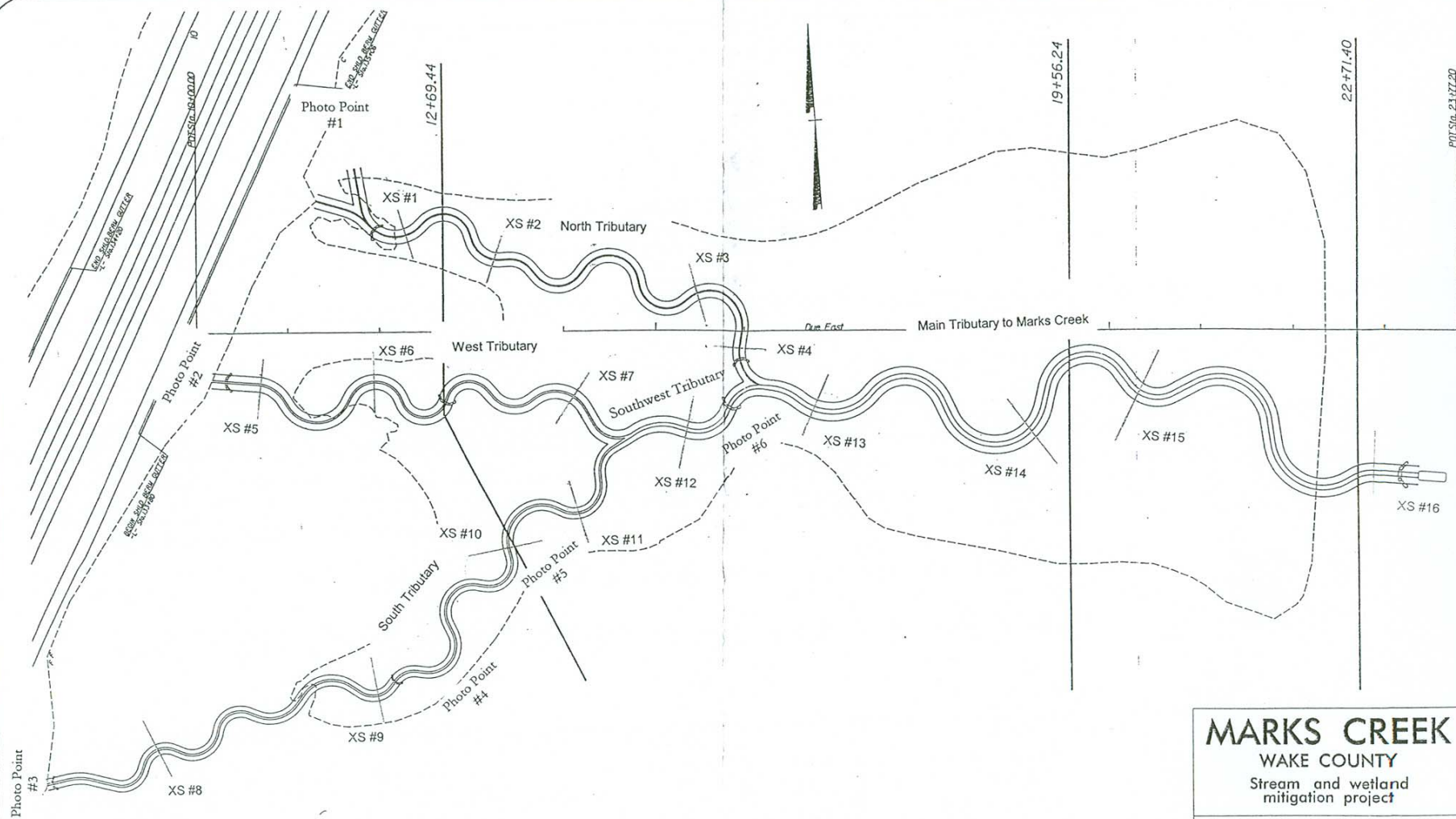


Photo 6

July 2007

# MARKS CREEK MITIGATION SITE





NOT TO SCALE

**MARKS CREEK**  
WAKE COUNTY  
Stream and wetland  
mitigation project

CROSS SECTION LOCATIONS  
**FIGURE 2**